Reduced Probability of HIV Infection among Crack Cocaine–Using Injection Drug Users

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ABSTRACT

Objectives. This study examined in greater detail the authors' previously reported finding that crack use among injection drug users is associated with lower levels of infection with the human immunodeficiency virus (HIV).

Methods. Self-reported data and blood tests for HIV antibodies from 4840 out-of-treatment injection drug users were used to examine relationships among crack use, HIV risk behavior, and HIV infection.

Results. Crack use was significantly associated with higher levels of many sexual risk and needle use behaviors and was consistently associated, independently of all behavioral variables examined, with lower rates of HIV infection.

Conclusions. Crack use among injection drug users appears to be associated with lower risk for HIV infection independently of other behavioral variables. (*Am J Public Health.* 1997;87:1008–1012)

Introduction

Numerous studies have linked cocaine injection to likelihood of infection with the human immunodeficiency virus (HIV),[1–8] and others have linked cocaine use to specific, high-risk injection behaviors.[1,3,9–11] Crack use among injection drug users has also been reported to be associated with more frequent drug injection,[12] renting needles and using shooting galleries,[13] number of sex partners,[6,12,13] having unprotected sex,[12] prostitution,[14] and having sex while intoxicated.[6] Among injection drug users in methadone maintenance treatment, crack use has been associated with more recent drug injection and with prostitution,[14] as well as with number of sex partners and use of shooting galleries.[15] However, another study found no association between crack use per se and specific sexual or injection-related risk behaviors among methadone patients.[9] One study[15] also found that crack-using injection drug users were more than twice as likely to be HIV infected as those reporting no crack use, but this relationship did not hold after control for other variables.

With one exception,[15] the study of crack use has focused on its association with risk behaviors rather than with actual HIV infection. However, in a recent study,[4] we reported that crack-using injection drug users were significantly less likely to be infected with HIV than those who reported no crack use (odds ratio [OR] = 2.26, 95% confidence interval [CI] = 1.75, 2.91; $P < .0001$). Moreover, this relationship held after control for other variables, eliminating the possibility that, for example, crack might serve as a substitute for injected cocaine. This finding was subsequently replicated.[5]

In this paper, we describe the observed relationship between crack use and HIV infection in greater detail. We examine the association of crack use with a wide range of variables to more fully describe crack users and nonusers and to rule out obvious hypotheses regarding the source of the association. We predicted that crack users would demonstrate higher risk behaviors than nonusers of crack, despite lower rates of HIV infection. We also expected to observe the same relationship between crack use and reduced risk for HIV infection within all categories of other behavioral and demographic risk variables. Thus, we anticipated being able to rule out expected behavioral and demographic differences between crack users and nonusers as the source of the relationship. We discuss other, nonbehavioral factors that we believe may account for the apparently protective value of crack use in this sample.

Methods

Readers interested in a detailed account of recruitment, data collection, and HIV testing procedures are referred to earlier reports.[4,5,16] Briefly, subjects were recruited via street outreach and word of mouth to storefront offices in Newark and Jersey City for interviews regarding drug use and sexual behavior and for HIV antibody testing. Recruitment included targeted outreach by recovering addicts in neighborhoods identified by a staff ethnographer as having a high level of drug activity. Outreach was expanded to other, less notorious neighborhoods as these areas became known to outreach staff.

For this study, we first sought to describe crack users in detail by means of a series of univariate (chi-square and analysis of variance) analyses of crack use against various demographic and behavioral variables. We then conducted a discriminant analysis on crack use using those variables most strongly associated

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with crack use in univariate analyses. For this analysis, years of drug injection and age were dichotomized at the sample mean, and number of sex partners was dichotomized according to whether subjects had multiple partners. Both univariate and multivariate analyses were intended to determine whether crack users appeared to be at behaviorally higher risk than nonusers. We also conducted a second set of chi-square analyses between crack use and HIV serostatus in which the infection rates of crack users and nonusers were compared within each level of each risk variable to confirm that no such mediating relationships had been overlooked in our earlier analyses. We have reported the results of our multivariate analysis of HIV status previously[4,5]; this analysis was not repeated in the present study. For all analyses, the significance level was set at $\alpha = .01$.

Results

Analyses conducted for this study included 4705 subjects. Sample characteristics have been described in detail elsewhere.[4,5] Overall, the sample had a seroprevalence rate of 40.5%, with crack users exhibiting a significantly lower infection rate (30.8%) than nonusers (45.0%; $\chi^2 = 17.97, P < .0001$).

Table 1 presents results of the univariate analyses of crack use. Crack users differed from nonusers on numerous dimensions. When the variables associated with crack use were entered into a discriminant analysis, the discriminant function accounted for 22.78% of the variance in crack use and correctly classified 67.28% of cases (Wilks's $\lambda = .8788$; $\chi^2 = 566.625$, $df = 18$, $P < .0001$). The multivariate analysis generally confirmed the trends observed in the univariate analyses. Of 20 variables examined in the analysis, 18 were significantly associated with crack use: HIV seronegativity, having multiple sex partners, younger age, daily alcohol use, frequent marijuana use, trading sex for drugs, lack of permanent housing, lifetime history of syphilis, being female, lifetime history of solvent abuse, shorter history of drug injection, lifetime history of gonorrhea, being Black, less than daily heroin injection, trading sex for money, less than daily injection of any drug, having a sex partner who injects drugs, and daily speedball injection. The standardized coefficients ranged in absolute magnitude from .0539 (frequency of speedball injection) to .3251 (HIV serostatus).

TABLE 1—Characteristics of Crack Users and Nonusers

	Crack Users (n = 1495)	Nonusers (n = 3210)	Statistic	*df*	*P*
HIV seropositive, %	30.8	45.0	82.09[a]	1	<.0001
Male, %	71.8	77.5	17.97[a]	1	<.0001
Race/ethnicity, %					
Black	74.8	67.6			
Hispanic	16.8	23.2			
White/other	8.4	9.2	28.51[a]	2	<.0001
High school education or more, %	44.0	41.2	3.38[a]	1	NS
Homeless, %	22.5	14.9	40.08[a]	1	<.0001
Frequency of drug injection, %					
Never	1.2	1.6			
Less than once per day	39.8	28.9			
Once per day or more	59.0	69.5	55.34[a]	2	<.0001
Frequency of cocaine injection, %					
Never	24.6	32.0			
Less than once per day	45.8	38.0			
Once per day or more	29.6	30.0	34.56[a]	2	<.0001
Frequency of heroin injection, %					
Never	7.6	6.4			
Less than once per day	37.2	28.4			
Once per day or more	55.2	65.2	43.86[a]	2	<.0001
Frequency of speedball injection, %					
Never	28.2	31.6			
Less than once per day	37.9	30.7			
Once per day or more	33.9	37.7	24.04[a]	2	<.0001
Rented/borrowed needles, %	32.6	25.5	25.15[a]	1	<.0001
Used shooting gallery, %	27.2	26.0	0.65[a]	1	NS
Never used bleach to clean needles, %	27.3	22.8	2.76[a]	1	NS
Had injection drug–using sex partner, %	47.5	33.0	89.46[a]	1	<.0001
Traded sex for money, %	12.5	3.9	121.58[a]	1	<.0001
Traded sex for drugs, %	13.7	4.1	89.46[a]	1	<.0001
Ever used condoms during sex, %	35.4	31.9	4.67[a]	1	NS
Mean age (SD)	32.9 (6.8)	34.7 (7.3)	65.92[b]	1	<.0001
Mean years of injection drug use (SD)	11.6 (8.0)	14.1 (8.7)	87.78[b]	1	<.0001
Mean no. sex partners (SD)	3.6 (12.3)	1.7 (3.2)	60.96[b]	1	<.0001

Note. Behavioral variables refer to past-month behavior, except as noted. Bleach use is reported only for those subjects indicating use of shared needles.
[a]Chi-square value.
[b]F value.

We had earlier determined that crack-using injection drug users were less likely to be infected with HIV than those who reported no crack use in the 6 months prior to interview, even after the influence of other variables had been statistically controlled in a logistic regression (regression coefficient = .3258, SE = .0731; $P < .0001$).[4] In this study, the association between use of crack and HIV infection was examined within each level of a wide range of demographic and behavioral variables in order to describe the phenomenon more fully. As indicated in Tables 2 and 3, crack use was significantly associated with lower HIV infection rates across levels of most of the variables examined. No significant association between crack use and higher rates of infection was detected.

We had speculated that the association between crack use and reduced risk

TABLE 2—Association between Crack Use and HIV Status across Demographic and Sexual Behavior Categories

	HIV Seroprevalence, %			
	Crack Users (n = 1495)	Nonusers (n = 3210)	χ^2	*P*
Sex				
Male (n = 3408)	30.5	46.2	72.75	<.0001
Female (n = 1090)	31.6	41.2	9.52	.0020
Race/ethnicity				
Black (n = 2896)	11.2	48.9	69.76	<.0001
Hispanic (n = 940)	22.8	37.6	16.89	<.0001
White/other (n = 394)	24.6	34.9	3.69	NS
Education				
Less than high school (n = 2611)	34.0	48.7	47.77	<.0001
High school or more (n = 1890)	26.6	39.9	32.05	<.0001
Homelessness				
Not homeless (n = 3722)	29.9	43.6	61.31	<.0001
Homeless (n = 776)	34.3	53.3	26.56	<.0001
Age, y				
<25 (n = 457)	15.5	11.3	1.34	NS
25–30 (n = 839)	21.2	27.2	3.53	NS
30–35 (n = 1213)	30.7	46.2	27.51	<.0001
35–40 (n = 1120)	45.3	58.6	15.19	.0001
40–50 (n = 753)	39.4	56.4	15.06	.0001
>50 (n = 109)	30.0	43.8	0.78	NS
Zip code of residence				
07102 (n = 83)	18.2	44.0	4.83	NS
07103 (n = 74)	41.7	52.0	0.34	NS
07104 (n = 83)	35.0	52.4	1.21	NS
07107 (n = 36)	38.5	34.8	0.00	NS
07108 (n = 62)	28.0	43.2	0.90	NS
07112 (n = 24)	20.0	50.0	1.14	NS
Had an injection drug–using sex partner				
No (n = 2911)	31.7	44.9	38.85	<.0001
Yes (n = 1755)	29.6	45.4	41.92	<.0001
Traded sex for money				
No (n = 4377)	30.0	45.1	82.50	<.0001
Yes (n = 311)	36.1	43.8	1.49	NS
Traded sex for drugs				
No (n = 4355)	30.4	45.0	77.23	<.0001
Yes (n = 335)	33.3	44.4	3.56	NS
Ever used condoms				
No (n = 2492)	27.6	40.4	38.62	<.0001
Yes (n = 1232)	32.1	47.1	26.03	<.0001
No. sex partners				
0 (n = 772)	44.3	54.9	5.23	NS
1 (n = 2190)	30.7	41.7	21.72	<.0001
2–5 (n = 1237)	26.6	44.6	42.62	<.0001
>5 (n = 301)	31.6	42.3	3.70	NS

Note. Behavioral variables refer to past-month behavior, except as noted. For all analyses, *df* = 1. Bleach use is reported only for subjects indicating needle sharing.

for HIV infection might have been the result of the uneven geographic distribution of both HIV infection and crack use. Specifically, we speculated that crack users might cluster in neighborhoods where HIV was less widespread. We therefore examined whether a subject's neighborhood of residence mediated the relationship between crack use and HIV. We examined the association between crack and HIV within each of seven postal zip codes provided by subjects in Newark (zip codes for Jersey City were unavailable). Results failed to reach statistical significance, but trends were in the expected direction in six of the seven zip codes (see Table 2). These findings suggest that the relationship is not accounted for by geographic asymmetries in the distribution of HIV.

Discussion

With few exceptions, crack use is associated with higher levels of risk behavior; nevertheless, it is associated, with equal consistency, with a reduced likelihood of HIV infection. Although some lower levels of risk behavior for crack users were observed (e.g., shorter injection drug use histories), these lower risk levels cannot account for the pattern, since the association between crack use and reduced infection rates was found at all levels of the variables examined and has previously been found to persist in multivariate analyses.[4,5] Geographic asymmetries in the distribution of HIV also appear unlikely to account for the pattern. The findings therefore necessitate consideration of other factors not measured in the present study.

Risk for HIV infection is a function not only of behaviors but also of the particular people with whom the individual engages in these behaviors. We believe that since the former cannot account for the observed relationship between HIV and crack use, it is appropriate to consider the latter. The role of assortative mixing among subgroups (the tendency for an individual to have contacts primarily with same- or other-subgroup members) in the spread of infectious disease has recently come under closer examination[17–20] and may offer insights into the findings presented here. (The attributes that define a subgroup may include both demographic [e.g., race, gender, sexual orientation] and behavioral [e.g., injection drug use, prostitution, crack use] variables.) Four factors appear to play a role in the distribution of contagion among subgroups[17]: initial rates of infection in each subgroup, rates of risk behaviors among members of each subgroup, likelihood of transmission from a given contact, and rate of mixing between the subgroups. The implications of this model concern the degree to which HIV is uniformly distributed across subgroups within a population. All else being equal, if a given subgroup (crack users) in the population of injection drug users initially exhibits a lower rate of HIV infection than another subgroup (crack nonusers), and if members of one group have relatively little contact with members of the other group, the model predicts that the disparity in infection rates will be maintained over time. The current findings are

TABLE 3—Association between Crack Use and HIV Status across Drug Use Behavior Categories

	HIV Seroprevalence, %			
	Crack Users (n = 1495)	Nonusers (n = 3210)	χ^2	*P*
Years injecting drugs				
<5 (n = 1020)	13.6	13.6	0.00	NS
5–10 (n = 735)	26.9	32.7	2.52	NS
10–15 (n = 742)	28.9	48.6	26.43	<.0001
15–20 (n = 864)	43.4	61.2	21.88	<.0001
>20 (n = 1097)	52.6	61.7	6.30	NS
Frequency of drug injection				
Never (n = 65)	12.5	18.4	0.295	NS
Less than daily (n = 1519)	26.7	35.9	13.34	.0003
Daily or more (n = 3103)	33.8	49.5	60.70	<.0001
Frequency of cocaine injection				
Never (n = 1392)	19.8	22.9	1.42	NS
Less than daily (n = 1899)	29.8	47.3	53.02	<.0001
Daily or more (n = 1400)	41.5	65.4	68.19	<.0001
Frequency of heroin injection				
Never (n = 318)	21.5	28.1	1.61	NS
Less than daily (n = 1463)	28.2	42.5	29.06	NS
Daily or more (n = 2908)	33.8	47.8	45.36	NS
Frequency of speedball injection				
Never (n = 1432)	16.4	20.8	3.50	NS
Less than daily (n = 1546)	33.0	48.7	34.60	<.0001
Daily or more (n = 1712)	40.4	62.2	66.17	<.0001
Ever borrowed or rented needles				
No (n = 3393)	27.4	41.2	55.10	<.0001
Yes (n = 1303)	37.7	56.1	39.24	<.0001
Ever used bleach to clean needles				
No (n = 295)	31.7	47.6	6.72	.0095
Yes (n = 909)	27.9	59.0	26.12	<.0001
Ever used shooting gallery				
No (n = 3280)	27.9	39.9	44.14	<.0001
Yes (n = 1193)	38.7	60.8	50.73	<.0001

Note. Behavioral variables refer to past-month behavior, except as noted. For all analyses, *df* = 1. Bleach use is reported only for subjects indicating needle sharing.

consistent with this prediction and with the hypothesis that crack-using injection drug users may tend to interact primarily with other crack-using, rather than crack-nonusing, injection drug users. This hypothesis could be tested by including a social network analysis of needle sharing behavior in epidemiological studies of HIV to determine whether the degree of social network insularity can account for some of the discrepancy in HIV infection rates between crack users and nonusers.

An important assumption in the preceding discussion is that between-group disparities can be maintained only if levels of risk behavior are similar. If crack users are at proportionally greater behavioral risk for infection, then HIV, once introduced, would be expected to spread more rapidly within that group, and between-group disparities would diminish over time. Crack users reported engaging in sexual and needle use risk behaviors at higher rates than crack nonusers; however, they also tended to inject drugs less frequently and to have much shorter histories of drug injection behavior. It may be that these differences have the net effect of placing crack users at similar behavioral risk; however, only a longitudinal study of the disparity between these groups will reveal the long-term implications of behavioral differences between crack users and nonusers.

In the present study, we have attempted to describe the relationship between crack use and HIV seronegativity in greater detail and to rule out obvious behavioral and demographic differences between the groups as the source of the phenomenon. The case we present for network effects in patterns of HIV distribution is admittedly speculative, because we did not collect data on subjects' needle-sharing partners. Moreover, other possibilities certainly exist to explain the pattern; for example, crack use may affect certain biological processes involved in viral transmission or replication. Nevertheless, the hypothesis that the structure of social networks mediates the association between crack use and HIV seronegativity bears further consideration. Crack-using injection drug users may constitute a distinct subpopulation with unique drug use patterns and social network compositions, and this must be considered in HIV epidemiology studies. An important addition to epidemiological studies of HIV would be the use of social network analyses to account for the uneven patterns of association and exposure that are apparent in this epidemic. □

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Low Prevalences of HIV Infection and Sexually Transmitted Disease among Female Commercial Sex Workers in Mexico City

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ABSTRACT

Objectives. This study tried to determine human immunodeficiency virus (HIV)/sexually transmitted disease (STD) prevalences among female commercial sex workers in Mexico City.

Methods. A sampling frame was constructed that included bars, massage parlors, and street corners.

Results. Prevalences for *Treponema pallidum,* herpes simplex virus type 2, HIV, *Neisseria gonorrhoeae,* and *Chlamydia trachomatis* were 6.4%, 65%, 0.6%, 3.7%, and 11.1%, respectively. A significant association was found between higher STD frequencies and working at street sites.

Conclusions. Most STD frequencies were lower in comparison with rates found for female sex workers in other countries. However, preventive programs against STD/HIV are needed in this population. (*Am J Public Health.* 1997;87:1012–1015)

Introduction

In Mexico, human immunodeficiency virus (HIV) infection initially affected homosexual and bisexual men with multiple partners. Currently, the virus is spreading to growing numbers of heterosexual individuals. The percentage of acquired immunodeficiency syndrome (AIDS) cases among women (with identified risk factors) increased from 0% in 1983/84 to 14% as of January 1, 1997[1,2] and heterosexual transmission in women rose from 28.8% in 1989 to 53.3% as of January 1, 1997.[3,4] However, little is known about the risks for HIV infection, as well as infection involving other sexually transmitted diseases (STDs), among female commercial sex workers in Mexico.

Commercial sex in Mexico City takes place under an abolitionist system, and, according to local city laws, prostitution is a misdemeanor.[5] Therefore, registries of workers or authorized work sites do not exist. In this report, we describe results related to several STD prevalences and their variation according to work sites in a random stratified sample of female commercial sex workers working in Mexico City.

Methods

During 1992, using direct observation, in-depth interviews, key informants, and focus groups, we constructed a sample frame of commercial sex work sites located in an urban area of Mexico City. Types of sites identified were street corners, bars, and massage parlors.

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